

WE CLAIM:

1. A method for maintaining germline stem cells of *Drosophila* comprising:
  - (a) providing a population comprised of said germline stem cells, and
  - (b) stimulating signal transduction by a bone morphogenetic protein (BMP) signaling pathway in at least one cell of said population; wherein said stimulation maintains more germline stem cells in said population as compared to a population which has not had signal transduction of said BMP signaling pathway stimulated.
2. A method according to Claim 1, wherein said population is maintained *in vivo* and said *Drosophila* has been genetically engineered to stimulate said signal transduction.
3. A method according to Claim 1, wherein said population is maintained *in vitro*.
4. A method according to Claim 1, wherein said germline stem cells are from ovary.
5. A method according to Claim 1, wherein said germline stem cells are from testis.
6. A method according to Claim 1 further comprising obtaining said germline stem cells from an embryo.
7. A method according to Claim 1, wherein said BMP signaling pathway is stimulated by providing at least 10% more Decapentaplegic (Dpp) activity to said population than is present in wildtype.
8. A method according to Claim 1, wherein said BMP signaling pathway is stimulated by at least mutating a *dpp* gene to a gain-of-function phenotype.
9. A method according to Claim 1, wherein said BMP signaling pathway is stimulated by at least providing a BMP to said population.
10. A method according to Claim 9, wherein said BMP is selected from the group consisting of Decapentaplegic (Dpp) protein, BMP-2, and BMP-4.

11. A method according to Claim 1, wherein said BMP signaling pathway is stimulated by at least mutating a type I or type II decapentaplegic (*dpp*) receptor to a gain-of-function phenotype.

Sub 1  
12. A method according to Claim 1, wherein said BMP signaling pathway is stimulated through at least one serine/threonine kinase receptor which specifically recognizes a BMP.

13. A method according to Claim 12, wherein said BMP receptor is selected from the group consisting of Saxophone (Sax), Thick veins (Tkv), and Punt (Put).

14. A method according to Claim 1, wherein said BMP signaling pathway is stimulated by altering activity of at least one signal transducer for receptor binding to a BMP.

15. A method according to Claim 14, wherein said signal transducer is selected from the group consisting of Mothers against *dpp* (Mad), Medea (Med), Daughters against *dpp* (Dad), Schnurri (Shn), and Brinker (Brk).

Sub 2  
16. A method according to Claim 1, wherein said BMP signaling pathway is stimulated by increasing expression of BMP in a cell of said population.

17. A method according to Claim 16, wherein BMP expression is increased by *hedgehog* (*hh*)-activated transcription or *wingless* (*wg*)-activated transcription, and BMP signaling is increased in at least some of the germline stem cells.

18. A method according to Claim 1, wherein said population is further comprised of at least one somatic cell selected from the group consisting of terminal filament cell, cap cell, inner sheath cell, hub cell, and cyst progenitor cell.

19. A method according to Claim 1, wherein at least one germline stem cell is cultured *in vitro* in contact with feeder cells expressing a bone morphogenetic protein (BMP).

20. A method according to Claim 1, wherein at least one germline stem cell is cultured *in vitro* in contact with at least some somatic niche cells.

21. A method according to Claim 1, wherein signal transduction through said BMP signaling pathway is stimulated by *in vitro* culturing said germline stem cells with a feeder layer of somatic cells which stimulate BMP signaling.

22. A method according to Claim 1, wherein signal transduction through said BMP signaling pathway is stimulated by *in vitro* culturing said germline stem cells in a culture medium which stimulates BMP signaling.

23. A method according to Claim 1 further comprising maintaining at least one of said germline stem cells in a pluripotent state.

24. A method according to Claim 1 further comprising maintaining at least one of said germline stem cells in a totipotent state.

50 25. A method according to Claim 1 further comprising transferring at least one of said stimulated germline stem cells into a host *Drosophila*.

26. A method according to Claim 25, wherein at least one of said transferred germline stem cells contributes to two or more differentiated cell lineages of said host *Drosophila*.

27. A method according to Claim 25, wherein at least one of said transferred germline stem cells contributes to a germline cell lineage of said host *Drosophila*.

28. A method according to Claim 1 further comprising mutating at least one gene of said germline stem cell's genome.

29. A method according to Claim 1 further comprising introducing one or more polynucleotides into said germline stem cell's genome.

30. A method according to Claim 1 further comprising integrating a polynucleotide by homologous recombination at a targeted genetic locus of said germline stem cell.

31. A method according to Claim 1 further comprising targeting at least one gene of said germline stem cell for homologous recombination, selecting at least one germline stem cell which has undergone homologous recombination of said gene, and transferring said homologously recombined germline stem cells into another *Drosophila* such that said targeted gene is genetically transmitted through said another *Drosophila*'s germline.

32. A cell population made by a method according to Claim 1, wherein there are at least ten germline stem cells in said population for each germline stem cell present prior to stimulation of BMP signaling.

33. A method for maintaining *Drosophila* stem cells comprising:  
(a) providing a population comprised of said stem cells, and  
(b) stimulating *decapentaplegic* (*dpp*) signaling such that more stem cells of said population are maintained as at least viable or undifferentiated as compared to a population of stem cells which has not been stimulated.

34. A method of reducing or eliminating stem cells or tumor cells of an organism comprising: repressing signal transduction by a bone morphogenetic protein (BMP) receptor pathway such that said stem cells or tumor cells are reduced or eliminated.

35. A method of increasing abundance of stem cells of an organism comprising: stimulating signal transduction by a bone morphogenetic protein (BMP) receptor pathway such that abundance of at least some stem cells is increased.

36. A method of increasing lifetime of stem cells of an organism comprising: stimulating signal transduction by a bone morphogenetic protein (BMP) receptor pathway such that said lifetime of at least some stem cells is increased.